



Lean Government Metrics Guide

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This Lean Government Metrics Guide is a resource to help government agencies understand and select metrics to support their implementation of Lean and Six Sigma—two powerful and proven methods to improve organizational performance. Metrics are the cornerstone of successful Lean and Six Sigma improvement efforts. When used effectively, metrics can be powerful mechanisms for helping organizations to achieve, assess, and communicate results. While this guide draws primarily on metrics experience from the U.S. Environmental Protection Agency (EPA) and state environmental agencies, it also incorporates metrics and information collected from other federal agencies.

This guide includes the following sections:

- Introduction to Metrics Used in Lean Government Efforts
- Lean Government Process Metrics
- Lean Government Organizational Metrics
- How to Select Lean Metrics
- Where to Find More Information

Introduction to Metrics Used in Lean Government Initiatives

Lean and Six Sigma place a strong emphasis on measuring, evaluating, and communicating performance results. In this context, metrics enable organizations using Lean and Six Sigma to:

- Identify and target the right problems during Lean and Six Sigma events and projects
- Evaluate potential process improvements and select appropriate actions for implementation
- Establish baselines for process performance and track progress over time
- Understand and communicate the results (outcomes) of Lean and Six Sigma efforts
- Inform and monitor efforts to deploy Lean and Six Sigma throughout an organization

This guide explores two major categories of metrics relevant to Lean and Six Sigma: *process metrics* and *organizational metrics*. *Process metrics* address a specific process or program and provide information on key attributes of the process such as time, cost, quality, outputs, and process complexity. *Organizational metrics* address characteristics of the broader organization or agency, providing information on the status of Lean deployment and morale.

It is important to remember that the Lean and Six Sigma metrics discussed in this guide should ultimately support progress toward achieving the agency's mission. In the case of EPA and many state environmental agencies, this means protecting human health and the environment. It is often helpful to consider goals and objectives that may be outlined in the agency or program's

strategic plan to ensure that Lean and Six Sigma metrics are aligned to measure and drive progress toward the agency mission and desired outcomes. To select measures that matter, it is first important to clarify how the targeted process or program is intended to advance the agency's mission and objectives. Logic models provide simple but powerful tools for describing how process or program activities produce outputs that (at least in theory) translate into desired short-term, medium-term, and long-term outcomes.

The Lean government process and organizational metrics described in this guide are grouped into the following subcategories.

Process Metrics

- Time: Time metrics evaluate the time to produce and deliver a product or service to customers, the portion of time that is spent processing the product or idle time, whether customers receive products or responses on time, and other time-related considerations.
- Cost: Cost metrics measure cost savings and the costs of products or processes, such as the amount of full-time equivalent employees needed for a process.
- Quality: Quality metrics examine the quality of products or services, such as customer satisfaction and whether documents are complete and accurate.
- Outputs: Output metrics track the production or activity of agency processes, such as the number of permits issued.
- Process complexity: Process complexity metrics describe the complexity and nature of a process, such as the number of handoffs and steps in the process.

Organizational Metrics

- Lean deployment: Lean deployment metrics measure the status of Lean implementation at an agency, such as the number of Lean events or trainings conducted.
- Morale: Morale metrics pertain to employee satisfaction and staff retention, including responses to staff surveys and turnover rate.

Table 1 lists examples of metrics that government agencies can use in Lean and Six Sigma efforts. Each of these metrics is described later in this guide. The next section describes how to think about identifying metrics that are most appropriate for your agency or organization.

Table 1: Overview of Lean Government Metrics

PROCESS METRICS		
Time Metrics	Cost Metrics	Quality Metrics
<div>⇒ Lead Time</div> <div>⇒ Best and Worst Completion Time</div> <div>⇒ Percent On-Time Delivery</div> <div>⇒ Processing Time</div> <div>⇒ Activity Ratio</div> <div>⇒ Value Added Time</div> <div>⇒ Non-Value Added Time</div> <div>⇒ Percent Value Added Time</div>	<div>⇒ Labor Savings</div> <div>⇒ Cost Savings</div> <div>⇒ Cost per Product</div>	<div>⇒ Customer Satisfaction</div> <div>⇒ Rework</div> <div>⇒ Percent Complete and Accurate</div> <div>⇒ Rolling First Pass Yield</div>
Output Metrics	Process Complexity Metrics	
<div>⇒ Production</div> <div>⇒ Backlog</div> <div>⇒ Work in Process</div> <div>⇒ Inventory</div>	<div>⇒ Process Steps</div> <div>⇒ Value Added Process Steps</div> <div>⇒ Decisions</div> <div>⇒ Delays</div> <div>⇒ Handoffs</div> <div>⇒ Loops</div> <div>⇒ Black Holes</div>	
ORGANIZATIONAL METRICS		
Lean Deployment	Morale Metrics	
<div>⇒ Lean Events Conducted</div> <div>⇒ Lean Event Participation</div> <div>⇒ Lean Training</div>	<div>⇒ Employee Satisfaction</div> <div>⇒ Turnover</div>	

Lean Government Process Metrics

Process metrics—metrics that address a specific process or program—enable agencies to achieve, assess, and communicate compelling process improvement results. Lean government process metrics support several objectives, including:

- Measuring wastes (non-value added activity) in processes (e.g., comparing processing time or value-added time to the total time to produce a product, including idle time)
- Informing selection of specific process improvement actions
- Evaluating progress made to address those wastes and the benefits of Lean and Six Sigma projects (e.g., cost savings, reductions in process steps, etc.)
- Assessing the overall performance of a process (e.g., customer satisfaction, percent of products delivered on time, etc.)

Government agencies can use Lean process metrics to answer the following types of questions:

- Time metrics: How long does it take to produce a product or deliver a service? How much of that time is processing time and how much is idle time?
- Cost metrics: How much does the process cost to operate (e.g., the number of full time equivalent employees)? What cost savings did the team identify in the Lean event?
- Quality metrics: How often does the process lead to mistakes (e.g., incomplete or inaccurate forms) that require rework? How do customers view the process?
- Output metrics: How many products (e.g., permits) are completed or processed each month or year? What backlogs exist in the process?
- Process complexity metrics: How many steps are in the process? How many times is a document handed off between individuals, offices, or departments in the process?

It is important to note that some types of metrics will likely be of greater interest to certain audiences, although all types are useful for understanding the varied dimensions that affect process performance and outcomes. For example:

- Lead time, customer satisfaction, and other measures of product or service quality may be of particular interest to key “customers,” those who receive and/or benefit from the process outputs and outcomes; and
- Other process metrics, such as those related to process complexity and efficiency, may be of particular interest to internal audiences such as managers of the process.

Table 2 below presents a range of Lean government process metrics. The table provides a brief description of each metric, an example of how the metric is used, and identifies whether one or more environmental agencies have used the metric in Lean government efforts. A special discussion of time metrics is included after Table 2, as several aspects of time metrics may be particularly new to those who are not familiar with Lean.

Table 2: Definitions and Examples of Lean Government Process Metrics

METRIC	DESCRIPTION	EXAMPLE	USED BY ENVIRONMENTAL AGENCIES?
<i>Time Metrics*</i>			
Lead Time (a.k.a. Elapsed Time)	Total time (from start to finish, from the customer’s perspective, including waiting time) to develop a product or deliver a service to a customer. Typically expressed in days.	Time between when a permit application was submitted (even if incomplete) and when customer receives a permit	✓
Best and Worst Completion Time	Estimate of the shortest (best) and longest (worst) time to complete the process (lead time is the average). <u>Note</u> : Lead time is more relevant to the customer.	15 days vs. 350 days	✓

METRIC	DESCRIPTION	EXAMPLE	USED BY ENVIRONMENTAL AGENCIES?
Percent On-Time Delivery	Percent of time the product/service is delivered on time, from the customer's perspective	45% of permits are issued within 90 days of receipt of application (as promised to customer)	✓
Processing Time (a.k.a. Cycle Time or "Touch Time")	Time to complete a process or process step, excluding wait time. (Lead time > total processing time > value added time)	1.5 days processing time	✓
Activity Ratio (or Process Efficiency)	Processing time divided by lead time, expressed as a percentage	1.5 days processing time ÷ 30 days lead time = 5%	Unknown
Value Added Time	Processing time that adds value from a customer's perspective (i.e., when information and materials are transformed into products or services a customer wants). ¹ Typically expressed in minutes or hours.	Actual time for substantive review of a permit (without interruptions or delays)	Unknown
Non-Value Added Time	Time that does not add value from a customer's perspective (i.e., when information and materials are not transformed into products or services a customer wants). Typically expressed in minutes or hours.	Time for transport of the document around the office; waiting time for someone to review the document; unnecessary approvals or signatures	Unknown
Percent Value Added Time	Value added time divided by lead time, expressed as a percentage. ²	4 hours value added time ÷ 30 days lead time = 0.56% value added	Unknown
Cost Metrics			
Labor Savings (or Freed Capacity)	<p>Change in the number of full time equivalent (FTE) employees needed for a process (i.e., FTEs that can be reassigned to other tasks/positions because of efficiency improvements).</p> <ul style="list-style-type: none"> FTEs required = (Sum of processing time [hours] X # of occurrences/year) ÷ 2,080 work hours/year Freed capacity = FTEs needed for current state – FTEs needed for future state 	<p>(14 hours processing time per permit application x 300 permit applications per year) ÷ 2,080 hours per year = 2 FTEs required</p> <p>5.5 FTEs for current state (before Lean event) – 2 FTEs for future state (after Lean event) = 3.5 FTEs freed capacity</p>	Unknown

¹ Value added time is widely used in Lean manufacturing, but difficult to define in administrative contexts. Processing time is easier to measure for office processes, so it can be used as a substitute.

² Value added time is widely used in Lean manufacturing, but difficult to define in administrative contexts. Activity ratio (processing time divided by lead time) can be used as a substitute for percent value added time.

METRIC	DESCRIPTION	EXAMPLE	USED BY ENVIRONMENTAL AGENCIES?
Cost Savings	Dollar savings from Lean or Six Sigma projects, such as: <ul style="list-style-type: none"> • Dollar value of FTE savings (e.g., from staff attrition and avoided need to hire) • Reductions in contractor costs (after subtracting Lean facilitator costs) • Other office cost savings (e.g., energy/utility costs, consolidating office space, avoided costs such as not needing a new IT system) 	Saved \$3 million from Lean events	Unknown
Cost per Product	Labor, material, and overhead costs to produce a product (or service product)	$(\$500 \text{ labor} + \$500 \text{ material} + \$1000 \text{ overhead}) \div 100 \text{ products per month} = \20 per unit	Unknown
Quality Metrics			
Customer Satisfaction	Qualitative or quantitative results from customer satisfaction surveys (e.g., about a service or product)	Customer satisfaction ratings improved from 4.2 to 7.8 out of 10	Unknown
Rework	Percent of products or work in process that needs to be redone	Percent of permit applications that are not complete and need to be redone	✓
Percent Complete and Accurate (C&A)	Percent of occurrences that work in process (e.g., a permit application) released to the next step does not require a downstream customer to make corrections or request information that should have been provided initially. This is another way to measure rework.	30% of permit applications received are complete and accurate	Unknown
Rolling First Pass Yield (or Rolling Throughput Yield)	Percent of occurrences that the product or document passes through the entire process without needing rework. This is the product of the C&A percentages for each process step, expressed as a percentage.	30% C&A x 60% C&A x 90% C&A = 16% rolling first pass yield	✓
Output Metrics			
Production	Number of products or service products produced	Number of permits issued	Unknown

METRIC	DESCRIPTION	EXAMPLE	USED BY ENVIRONMENTAL AGENCIES?
Backlog	Number of products or service products that have not been started or entered the process	A Lean project eliminated a backlog of 300 permits.	✓
Work in Process (WIP)	Amount of products or transactions that are being processed or waiting to be processed	49 permit applications are in the process	Unknown
Inventory	A supply of raw materials, finished products, and/or unfinished products in excess of customer demand	Additional paper supplies beyond that needed for finished products	Unknown
Process Complexity Metrics			
Process Steps	Total number of steps in a process where a task or activity is performed	A Lean event reduced the number of process steps from 55 to 12.	✓
Value Added Process Steps	Number of process steps that add value from a customer's perspective (i.e., steps where information and materials are transformed into products/ services a customer wants). This number typically does not change with Lean.	3 steps are value added (e.g., they involve substantive review of permit conditions and writing the permit).	✓
Decisions	Number of points in process where a choice is made about a course of action	Before the Lean event, decisions were made at 4 points in the process.	✓
Delays	Number of points in process where time is wasted by waiting for something to occur	The number of steps with delays was reduced from 22 to 12.	✓
Handoffs	Number of times work is passed from one entity to another	The process had 18 handoffs between individuals before the Lean event and 6 after the event.	✓
Loops	Number of times when there are a series of steps that loop backwards and repeat themselves at least once	One of the loops between the permit reviewer and permit writer was eliminated with the new process.	✓
Black Holes	Number of extreme combinations of loops, delays, decisions, and handoffs from which no further progress is made or where years can pass before proceeding with the process	The Lean event eliminated the "black hole" in the process.	✓

Special Considerations about Time Metrics

Lean methods give special consideration to various aspects of process time. By examining how time is spent within a process, one can find important clues that reveal waste (non-value-added activity) and improvement opportunities. Keep in mind the following considerations about time metrics:

- Lead time is greater than total processing time which is greater than value added time. A common goal of Lean initiatives is to reduce lead time and total processing time to be closer to the value added time.
- In some cases it may even make sense to increase value added time (e.g., to improve quality) while simultaneously reducing overall lead time and processing time.
- In the manufacturing context, it is relatively easy to determine the portion of time that is value added—when workers or machines physically transform the form, fit, or function of the product in a way the customer is willing to pay for. In administrative processes, it can be more difficult to delineate what portion of the time is truly value added, from the customer’s perspective. For example, only a portion of the time a staff person reviews a permit application and drafts a permit is likely to be value added.
- Some Lean office publications suggest using “processing time” (also referred to as “touch time”) as an alternate metric to “value-added time,” since processing time is easier to measure. The activity ratio (ratio of processing time to lead time) then becomes the substitute metric for the value added percentage (ratio of value added time to lead time).

Lean Government Organizational Metrics

Organizational metrics—metrics that address topics such as Lean deployment and morale at an organizational level—help agencies to sustain and expand results that contribute to the agency’s ability to fulfill its mission. Lean government process metrics support a key objective:

- Inform and monitor efforts to deploy Lean and Six Sigma throughout an organization

Organizational metrics can help answer the following types of questions:

- Lean deployment metrics: How many Lean events have we completed this year? How many employees have participated in Lean training classes?
- Morale metrics: How satisfied are employees with the agency or office? What is the staff turnover rate, and how does it compare to the average for government agencies?

Table 3 provides descriptions and examples of Lean government organizational metrics.

Table 3: Definitions and Examples of Lean Government Organizational Metrics

METRIC	DESCRIPTION	EXAMPLE	USED BY ENVIRONMENTAL AGENCIES?
<i>Lean Deployment Metrics</i>			
Lean Events Conducted	Number of Lean events conducted (e.g., value stream mapping events, kaizen events, etc.). Some organizations only count implementation-oriented events (e.g., kaizen events).	An agency conducted 5 kaizen events this year.	✓
Lean Event Participation	Number of employees who have participated in Lean events. This can be broken down further, such as the number of employees that have participated in: <ul style="list-style-type: none"> • 1-5 Lean events • 6-12 Lean events • 13-25 Lean events • More than 25 Lean events 	100 employees participated in Lean events this year.	✓
Lean Training	Number of employees who have undergone formal Lean and/or Six Sigma training	5 employees completed Lean Six Sigma green belt training; 50 employees attended a “Lean 101” course.	✓
<i>Morale Metrics</i>			
Employee Satisfaction	Qualitative or quantitative results from staff surveys	70% of staff rated their employment with the agency as “good” or “very good” in a survey.	Unknown
Turnover	Percent of staff who leave the agency over a certain time period (e.g., month or year). <ul style="list-style-type: none"> • $\text{Turnover} = \frac{\# \text{ of employees leaving in a certain period}}{\text{total employed that period}}$ <p>It can also be useful to distinguish between voluntary and involuntary turnover.</p>	Staff turnover was 14% last year.	Unknown

How to Select Lean Metrics

This guide presents a menu of options for Lean government metrics, including examples of metrics that EPA and state environmental agencies have used in Lean and Six Sigma efforts. Not all of these metrics may be relevant and useful for your agency or organization, however. It is important to choose metrics that make sense for your agency, given your agency's overall goals and objectives. Consider these guidelines when selecting metrics:

- *Determine the purpose of the metrics.* Measures can drive behavior and focus attention in powerful ways. As a result, it is important to think about behaviors that are likely to be encouraged by use of specific metrics. In selecting metrics, consider questions such as:
 - What is the purpose of the metric? What aspects of the process are we trying to improve? What wastes are we trying to eliminate? What behaviors are we trying to reinforce?
 - Who are the key audiences for the metric?
 - How will we use the measurement data?
- *Use just a few metrics.* No more than a few metrics per category are needed. Having too many metrics dilutes the focus of the improvement efforts and can create unnecessary work.
- *Use only the most appropriate metrics.* Ask whether there is something important about a targeted process related to each category of process metrics, and do not worry if the answer is “no.” Also consider which metrics would be useful to evaluate across the agency, depending on the overall status and goals of the Lean or Six Sigma initiative.
- *Focus on customers and agency leadership needs.* While a range of metrics can show improvements made during Lean events (e.g., reductions in the number of process steps), only a few metrics matter to customers, including the time it takes to receive a service or product (lead time) and the quality of the service or product. Make sure to include some metrics that reflect key interests of customers, along with metrics that will resonate with agency leadership and support the agency's strategic goals.
- *Engage data users in the design of the metrics.* It's important to engage people who are familiar with the process in the design of metrics and the development of a system for collecting and reporting performance data. Without consulting front-line employees, agencies risk choosing metrics that are poorly understood, irrelevant, or inconsistently used by the people who do the work.

A widely used framework for choosing metrics is the “SMART” model—metrics should be Simple, Measurable, Actionable, Relevant, and Timely.³ This framework includes the following considerations:

- **Simple:** Make sure that metrics are transparent and simple enough to be easily understood by everyone in the agency. Metrics should also be hard to fool or game (e.g., avoid situations where people could show results even when nothing had actually changed).

³ There are several variations on this model, which is consistent with the principles for performance measurement outlined in Peter Drucker's 1954 book, *The Practice of Management*. Alternate terms for the SMART mnemonic include: Specific, Meaningful, Attainable, Reliable, and Time-bound.

- **Measurable:** Select metrics for which you can relatively easily collect performance data; don't rely on estimates or assumptions. In some cases, you may need to set up a system for collecting input, such as a customer satisfaction or voice of employee survey.
- **Actionable:** Metrics should provide information that managers and staff can use to take actions to improve the agency's operations and outcomes.
- **Relevant:** As is often stated, what you measure is what matters and gets managed. Select metrics that support the agency's strategic objectives and that specifically relate to the process or task at hand. For Lean efforts, this often means using metrics that correspond to the seven "deadly wastes" targeted by Lean (defects, overproduction, transport, motion, inventory, over processing, and idle time).
- **Timely:** Consider the "just-in-time" model for metrics—provide the right information to the right people when they need it for making decisions.

Where to Find More Information

As mentioned earlier, this guide provides an introduction to metrics that government agencies can use to implement and assess their Lean and Six Sigma initiatives. It is important to consider what metrics make the most sense given each agency's specific goals and objectives. Lean and Six Sigma books, articles, and training courses provide more information and guidance on selecting and using metrics. While numerous Lean and Six Sigma publications describe metrics, the following list of selected references include information on the use of metrics in administrative or office contexts:

- Fabrizio, Tom and Don Tapping. *5S for the Office: Organizing the Workplace to Eliminate Waste*. New York: Productivity Press, 2006.
- Keyte, Beau and Drew Locher. *The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes*. New York: Productivity Press, 2004.
- Martin, James William. *Lean Six Sigma for the Office*. Boca Raton: CRC Press, 2009.
- Martin, Karen. *Kaizen Event Planner: Achieving Rapid Improvement in Office, Service, and Technical Environments*. New York: Productivity Press, 2007.
- Tapping, Don and Tom Shuker. *Value Stream Management for the Lean Office: Eight Steps to Planning, Mapping, and Sustaining Lean Improvements in Administrative Areas*. New York: Productivity Press, 2003.

EPA's Lean Government website (www.epa.gov/lean) has a variety of resources and information on Lean and Six Sigma efforts at government agencies. For additional information and context on the use of Lean metrics, see EPA's *Lean in Government Starter Kit*, which provides guidance and resources on implementing Lean events at government agencies. EPA's Lean Government website also has case studies and other publications describing results and lessons learned from EPA and state environmental agency Lean events. EPA is interested in the results, experiences, and lessons learned from your agency's Lean and Six Sigma efforts.

EPA Lean Government Contact

To learn more about EPA's Lean Government Initiative and to share your ideas and experiences, visit the EPA Lean website (www.epa.gov/lean) or contact:

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